Geophysical Research Abstracts
Vol. 17, EGU2015-11357-2, 2015
EGU General Assembly 2015

Shape and rotational elements of comet 67P/ Churyumov-Gerasimenko derived by stereo-photogrammetric analysis of OSIRIS NAC image data

Frank Preusker (1), Frank Scholten (1), Klaus-Dieter Matz (1), Thomas Roatsch (1), Konrad Willner (1), Stubbe Hviid (1), Jörg Knollenberg (1), Ekkehard Kührt (1), and Holger Sierks (2)

(1) Institute of Planetary Research, Planetary Geodesy, Berlin, Germany (contact: frank.preusker@dlr.de), (2) Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg, 3, 37077, Göttingen, Germany

The European Space Agency's Rosetta spacecraft is equipped with the OSIRIS imaging system which consists of a wide-angle and a narrow-angle camera (WAC and NAC). After the approach phase, Rosetta was inserted into a descent trajectory of comet 67P/Churyumov-Gerasimenko (C-G) in early August 2014. Until early September, OSIRIS acquired several hundred NAC images of C-G's surface at different scales (from $\sim$5 m/pixel during approach to $\sim$0.9 m/pixel during descent). In that one month observation period, the surface was imaged several times within different mapping sequences. With the comet's rotation period of $\sim$12.4 h and the low spacecraft velocity (< 1 m/s), the entire NAC dataset provides multiple NAC stereo coverage, adequate for stereo-photogrammetric (SPG) analysis towards the derivation of 3D surface models.
We constrained the OSIRIS NAC images with our stereo requirements (15° < stereo angles < 45°, incidence angles <85°, emission angles <45°, differences in illumination < 10°, scale better than 5 m/pixel) and extracted about 220 NAC images that provide at least triple stereo image coverage for the entire illuminated surface in about 250 independent multi-stereo image combinations. For each image combination we determined tie points by multi-image matching in order to set-up a 3D control network and a dense surface point cloud for the precise reconstruction of C-G's shape.
The control point network defines the input for a stereo-photogrammetric least squares adjustment. Based on the statistical analysis of adjustments we first refined C-G's rotational state (pole orientation and rotational period) and its behavior over time. Based upon this description of the orientation of C-G's body-fixed reference frame, we derived corrections for the nominal navigation data (pointing and position) within a final stereo-photogrammetric block adjustment where the mean 3D point accuracy of more than 100 million surface points has been improved from $\sim$10 m to the sub-meter range. We finally applied point filtering and interpolation techniques to these surface 3D points and show the resulting SPG-based 3D surface model with a lateral sampling rate of about 2 m.